a. Requesting Approval. Any operator requesting approval under FAR Section 121.161 for extended range operations with two-engine airplanes (after providing an acceptable evaluation of the considerations in Paragraphs 8 and 9) should submit the requests, with the required supporting data, to the certificate-holding district office at least 60 days prior to the proposed start of extended range operation with the specific airframe-engine combination. In considering an application from an operator to conduct extended range operations, an assessment should be made of the operator's overall safety record, past performance, flightcrew training, and maintenance programs. The data provided with the request should substantiate the operator's ability and competence to safely conduct and support these operations and should include the means used to satisfy the considerations outlined in this paragraph. (Any reliability assessment obtained, either through analysis or service experience, should be used as guidance in support of operational judgments regarding the suitability of the intended operation.)

b. Assessment of the Operator's Propulsion System Reliability. Following the accumulation of adequate operating experience by the world fleet of the specified airframe-engine combination and the establishment of an IFSD rate objective in accordance with Appendix 1 for use in ensuring the propulsion system reliability necessary for extended range operations, an assessment should be made of the applicant's ability to achieve and maintain this level of propulsion system reliability. This assessment should include trend comparisons of the operator's data with other operators as well as the world fleet average values, and the application of a qualitative judgment that considers all of the relevant factors. The operator's past record of propulsion system reliability with related types of power units should also be reviewed, as well as its record of achieved systems reliability with the airframe-engine combination for which authorization is sought to conduct extended range operations.

c. Engineering Modifications and Maintenance Program Considerations. Although these considerations are normally part of the operator's continuing airworthiness program, the maintenance and reliability program may need to be supplemented in consideration of the special requirements of extended range operation (Appendix 4). The following items, as part of the operator's program, will be reviewed to ensure that they are adequate for extended range operations:

(1) Engineering Modifications. The operator should provide to the certificate-holding district office all titles and numbers of all modifications, additions, and changes which were made in order to substantiate the incorporation of the CMP standard in the airplanes used in extended range operation.

(2) Maintenance Procedures. Following approval of the changes in the maintenance and training procedures, substantial

changes to maintenance and training procedures, practices, or limitations established to qualify for extended range operations should be submitted to the certificate-holding district office 60 days before such changes may be adopted.

(3) Reliability Reporting. The reliability reporting program as supplemented and approved, should be implemented prior to and continued after approval of extended range operation. Data from this process should result in a suitable summary of problem events, reliability trends and corrective actions and be provided regularly to the certificate-holding district office. Appendix 4 contains additional information concerning propulsion and airframe system reliability monitoring and reporting.

(4) Approved modifications and inspections which would maintain the reliability objective for the propulsion and airframe systems as a consequence of Airworthiness Directive (AD) actions and revised CMP standards should be promptly implemented. Other recommendations made by the engine and airframe manufacturers should also be considered for prompt implementation. This would apply to both installed and spare parts.

(5) Procedures and centralized control process should be established which would preclude an airplane being dispatched for extended range operation after propulsion system shutdown or primary airframe system failure on a previous flight, or significant adverse trends in system performance, without appropriate corrective action having been taken. Confirmation of such action as being appropriate, in some cases, may require the successful completion of one or more nonrevenue or non-ETOP revenue flights (as appropriate) prior to dispatch on an extended range operation.

(6) The program used to ensure that the airborne equipment will continue to be maintained at the level of performance and reliability necessary for extended range operations.

(7) Engine condition monitoring program.

(8) Engine oil consumption monitoring program.

d. Flight Dispatch Considerations.

(1) General. The flight dispatch considerations specified in this section are in addition to, or amplify, the requirements contained in FAR Part 121 and specifically apply to extended range operations. Although many of the considerations in this AC are currently incorporated into approved programs for other airplanes or route structures, the unique nature of extended range operations with two-engine airplanes necessitates a reexamination of these operations to ensure that the approved programs are adequate for this purpose.

(2) Master Minimum Equipment List (MMEL). System redundancy levels appropriate to extended range operations should be reflected in the MMEL. An operator's MEL may be more restrictive than the MMEL considering the kind of ER operation proposed and equipment and service problems unique to the operator. Systems considered to have a fundamental influence on flight safety may include, but are not limited to the following:

(i) Electrical, including battery;

(ii) Hydraulic;

(iii) Pneumatic;

(iv) Flight instrumentation;

(v) Fuel;

(vi) Flight control;

(vii) Ice protection;

(viii) Engine start and ignition;

(ix) Propulsion system instruments;

(x) Navigation and communications;

(xi) Auxiliary power-units;

(xii) Air conditioning and pressurization;

(xiii) Cargo fire suppression;

(xiv) Emergency equipment; and

(xv) Any other equipment necessary for extended range operations.

(3) Communication and Navigation Facilities. An airplane should not be dispatched on an extended range operation unless:

(i) Communications facilities are available to provide under normal conditions of propagation at the normal one-engine inoperative cruise altitudes, reliable two-way voice communications between the airplane and the appropriate air traffic control unit over the planned route of flight and the routes to any suitable alternate to be used in the event of diversion;

(ii) Nonvisual ground navigation aids are available and located so as to provide, taking account of the navigation equipment installed in the airplane, the navigation accuracy

necessary for the planned route and altitude of flight, and the routes to any alternate and altitudes to be used in the event of an engine shutdown; and

(iii) Visual and nonvisual aids are available at the specified alternates for the authorized types of approaches and operation minima.

(4) Fuel and Oil Supply.

(i) General. An airplane should not be dispatched on an extended range operation unless it carries sufficient fuel and oil to meet the requirements of FAR Part 121, and any additional fuel that may be determined in accordance with subparagraph 10.d.(4)(ii). In computing fuel requirements, advantage may be taken of driftdown and at least the following should be considered as applicable:

(A) Current forecast winds and meteorological conditions along the expected flightpath at one-engine inoperative cruising altitude and throughout the approach and landing;

(B) Any necessary operation of ice protection systems and performance loss due to ice accretion on the unprotected surfaces of the airplane;

(C) Any necessary operation of auxiliary power units;

(D) Loss of airplane pressurization and air conditioning; consideration should be given to flying at an altitude meeting oxygen requirements in the event of loss of pressurization;

(E) An approach followed by a missed approach and a subsequent approach and landing;

(F) Navigational accuracy necessary; and

(G) Any known Air Traffic Control (ATC) constraints.

(ii) Critical Fuel Reserves. In establishing the critical fuel reserves, the applicant is to determine the fuel necessary to fly to the most critical point and execute a diversion to a suitable alternate under the conditions outlined in subparagraph 10.d.(4)(iii)--the Critical Fuel Scenario. These critical fuel reserves should be compared to the normal FAR Part 121 requirements for the flight. If it is determined by this comparison that the fuel to complete the critical fuel scenario exceeds the fuel that would be on board at the most critical point, as determined by Part 121 requirements of the FAR, additional fuel should be included to the extent necessary to safely complete the

critical fuel scenario. In consideration of the items listed in subparagraph 10.d.(4)(i), the critical fuel scenario should allow for: a contingency figure of 5 percent added to the calculated fuel burn from the critical point to allow for errors in wind forecasts, a 5 percent penalty in fuel mileage**, any Configuration Deviation List items, both airframe and engine anti-icing; and account for ice accumulation on unprotected surfaces if icing conditions are likely to be encountered during the diversion. If the APU is a required power source, then its fuel consumption should be accounted for during the appropriate phase(s) of flight. (**In lieu of an applicant's established value for inservice deterioration in cruise fuel mileage.)

(iii) Critical Fuel Scenario. The following describes a scenario for a diversion at the most critical point. The applicant should confirm the scenario to be used in determining the critical fuel reserve necessary is operationally the most critical considering both time and airplane configuration (e.g., 2 engine versus 1 engine at 10,000 feet, nonstandard airplane configuration not shown to be extremely improbable, paragraph 8.c.(2)(ii)(D)).

(A) At the critical point, consider simultaneous failure of an engine and the pressurization system (critical point based on time to a suitable alternate at the approved one-engine inoperative cruise speed).

(B) Immediate descent to and continued cruise at 10,000 feet at the approved one-engine inoperative cruise speed or continued cruise above 10,000 feet if the airplane is equipped with sufficient supplemental oxygen in accordance with FAR Section 121.329.

(C) Upon approaching destination, descent to 1,500 feet above destination, hold for 15 minutes, initiation of an approach followed by a missed approach and then execution of a normal approach and landing.

(5) Alternate Airports. An airplane should not be dispatched on an extended range operation unless the required takeoff, destination and alternate airports, including suitable en route alternate airports to be used in the event of engine shutdown or airplane system failure(s) which require a diversion, are listed in the cockpit documentation (e.g., computerized flight plan). Suitable en route alternates should also be identified and listed in the dispatch release for all cases where the planned route of flight contains a point more than one hour flying time at the one-engine inoperative speed from an adequate airport. Since these suitable en route alternates serve a different purpose than the destination alternate airport and would normally be used only in the event of an engine failure or the loss of primary airplane systems, an airport should not be listed as a suitable en route alternate unless:

(i) The landing distances required as specified in the AFM for the altitude of the airport, for the runway expected to be used, taking into account wind conditions, runway surface conditions, and airplane handling characteristics, permit the airplane to be stopped within the landing distance available as declared by the airport authorities and computed in accordance with FAR Part 121.197.

(ii) The airport services and facilities are adequate for the applicant operator's approved approach procedure(s) and operating minima for the runway expected to be used; and

(iii) The latest available forecast weather conditions for a period commencing one hour before the established earliest time of landing and ending one hour after the established latest time of landing at that airport, equals or exceeds the authorized weather minima for en route alternate airports in Appendix 3. In addition, for the period commencing one hour before the established earliest time of landing, and ending one hour after the established latest time of landing at that airport, the forecast crosswind component, including gusts, for the landing runway expected to be used should be less than the maximum permitted crosswind for landing.

(iv) During the course of the flight, the flightcrew should be informed of any significant changes in conditions at designated en route alternates. Prior to a 120-minute extended range flight proceeding beyond the extended range entry point, the forecast weather for the time periods established in subparagraph 10d(5)(iii), landing distances, and airport services and facilities at designated en route alternates should be evaluated. If any conditions are identified (such as weather forecast below landing minima) which would preclude safe approach and landing, then the pilot should be notified and an acceptable alternate(s) selected where safe approach and landing can be made.

(6) Airplane Performance Data. No airplane should be dispatched on an extended range flight unless the operator's Operations Manual contains sufficient data to support the critical fuel reserve and area of operations calculation. The following data should be based on FAA-approved (see Paragraph 8.d.(3)) information provided or referenced in the Airplane Flight Manual.

(i) Detailed one-engine inoperative performance data including fuel flow for standard and nonstandard atmospheric conditions and as a function of airspeed and power setting, where appropriate, covering

(A) Driftdown (includes net performance);

(B) Cruise altitude coverage including 10,000 feet;

(C) Holding;

(D) Altitude capability (includes net performance); and

(E) Missed approach.

(ii) Detailed all-engine-operating performance data, including nominal fuel flow data, for standard and nonstandard atmospheric conditions and as a function of airspeed and power setting, where appropriate, covering:

(A) Cruise (altitude coverage including 10,000 feet); and

(B) Holding.

(iii) Details of any other conditions relevant to extended range operations which can cause significant deterioration of performance, such as ice accumulation on the unprotected surfaces of the airplane, RAM Air Turbine (RAT) deployment, thrust reverser deployment, etc.

(iv) The altitudes, airspeeds, thrust settings, and fuel flow used in establishing the ETOPS area of operations for each airframe-engine combination must be used in showing the corresponding terrain and obstruction clearances in accordance with FAR Section 121.191.

e. Flightcrew Training, Evaluation, and Operating Manuals.

(1) Adequacy of Flightcrew Training and Operating Manuals. The FAA will review inservice experience of critical and essential airplane systems. The review will include system reliability levels and individual event circumstances, including crew actions taken in response to equipment failures or unavailabilities. The purpose of the review will be to verify the adequacy of information provided in training programs and operating manuals. The aviation industry should provide information for and participate in these reviews. The FAA will use the information resulting from these reviews to modify or update flightcrew training programs, operating manuals, and checklists, as necessary.

(2) Flightcrew Training and Evaluation Program. The operator's training program in respect to extended range operations should provide training for flight crewmembers followed by subsequent evaluations and proficiency checks in the following areas:

(i) Performance.

(A) Flight planning, including all contingencies.

(B) Flight performance progress monitoring.

(ii) Procedures.

(A) Diversion procedures.

(B) Use of appropriate navigation and communication systems.

(C) Abnormal and emergency procedures to be followed in the event of foreseeable failures, including:

(1) Procedures for single and multiple failures in flight that would precipitate go/no-go and diversion decisions.

(2) Operational restrictions associated with these failures including any applicable MEL considerations.

(3) Procedures for air start of the propulsion systems, including the APU, if required.

(4) Crew incapacitation.

(D) Use of emergency equipment including protective breathing and ditching equipment.

(E) Procedures to be followed in the event that there is a change in conditions at designated en route alternates which would preclude safe approach and landing.

(F) Understanding and effective use of approved additional or modified equipment required for extended range operations.

(G) Fuel Management. Flightcrew should be trained on the fuel management procedures to be followed during the en route portion of the flight. These procedures should provide for an independent cross-check of fuel quantity indicators. For example, fuel flows could be used to calculate fuel burned and compared to indicated fuel remaining.

(3) ETOPS Check Airman. The operator should designate specific ETOPS check airman. The objective of the ETOPS check airman program should be to ensure standardized flightcrew practices and procedures and also to emphasize the special nature of ETOPS operations. Only airmen with a demonstrated

understanding of the unique requirements of ETOPS should be designated as a check airman.

f. Operational Limitations.

(1) Area of Operation.

(i) An operator may be authorized to conduct extended range operations within an area where the diversion time at any point along the proposed route of flight to an adequate airport is 75, 120 or 180 minutes at the approved one-engine cruise speed (under standard conditions in still air). Appendices 1, 4, and 5 provide criteria for operation at the different diversion times.

(ii) The area which meets the considerations in Paragraph 9.f.(1)(i) may be approved for extended range operations with two-engine airplanes and should be specified in the operations specifications as the authorized area of operations.

(2) Flight Dispatch Limitation. The flight dispatch limitation should specify the maximum diversion time from a suitable airport an operator can conduct a particular extended range operation. The maximum diversion time at the approved one-engine inoperative cruise speed (under standard conditions in still air) should not be any greater than the value established by subparagraph 10.f.(1)(i).

(i) Use of Maximum Diversion Time. The flight dispatch considerations should ensure that extended range operation is limited to flight plan routes where the approved maximum diversion time to suitable airports can be met. Operators should provide for:

(A) Compliance with FAR Section 121.565 where, upon occurrence of an in-flight shutdown of an engine, the pilot should promptly initiate diversion to fly to and land at the nearest airport, in point of time, determined to be suitable by the flightcrew.

(B) A practice to be established such that in the event of a single or multiple primary system failure, the pilot will initiate the diversion procedure to fly and land at the nearest suitable airport, unless it has been demonstrated that no substantial degradation of safety results from continuation of the planned flight.

(ii) Criteria for Maximum Diversion Times. The criteria for different maximum diversion times are detailed in Appendices 1, 4, and 5.

(3) Contingency procedures should not be interpreted in

anyway which prejudices the final authority and responsibility of the pilot in command for the safe operation of the airplane.

g. Operations Specifications.

(1) An operator's two-engine airplane should not be operated on an extended range flight unless authorized by operations specifications approval (both maintenance and operations).

(2) Operations specifications for extended range operations should specifically include provisions covering at least the following:

(i) Part D should define the particular airframe-engine combinations, including the current approved CMP standard required for extended range operation as normally identified in the AFM (paragraph 8.f.).

(ii) Authorized area of operation.

(iii) Minimum altitudes to be flown along planned and diversionary routes.

(iv) The maximum diversion time, at the approved one-engine inoperative cruise speed (under standard conditions in still air), that any point on the route the airplane may be from a suitable airport for landing.

(v) Airports authorized for use, including alternates, and associated instrument approaches and operating minima.

(vi) The approved maintenance and reliability program (ref. Appendix 4) for extended range operations including those items specified in the type design approved CMP standard.

(vii) Identification of those airplanes designated for extended range operation by make and model as well as serial and registration numbers.

(viii) Airplane Performance Reference.

h. Operational Validation Flight. The operator should demonstrate, by means of an FAA-witnessed validation flight using the specified airframe-engine combination, that it has the competence and capability to safely conduct and adequately support the intended operation. (This is in addition to the flight test required for type design approval in Paragraph 8.d.(3)). The Director, Flight Standards Service, will determine the conditions for each operator's validation flight following a review on a case-by-case basis of the operator's experience and the proposed operation. The following emergency conditions should be

demonstrated during the validation flight unless successful demonstration of these conditions has been witnessed by the FAA in an acceptable simulation prior to the validation flight:

(1) Total loss of thrust of one-engine; and total loss of engine-generated electrical power;

OR,

(2) Any other condition considered to be more critical in terms of airworthiness, crew workload, or performance risk.

i. Extended Range Operations Approval. Following a type design approval for extended range operations in accordance with paragraph 8 and satisfactory application of the criteria in paragraphs 9 and 10 and prior to the issuance of operations specifications, the operator's application, as well as, the certificate-holding district office's principal inspectors' (Principal Maintenance Inspector, Principal Avionics Inspector, Principal Operations Inspector) recommendations and supporting data should be forwarded to the Director, Flight Standards Service, for review and concurrence. Following the review and concurrence by the Director, the operational validation flight should be conducted in accordance with any additional guidance specified in the review and concurrence. When the operational validation flight has been evaluated and found acceptable, an applicant may be authorized to conduct extended range operations with the specified airframe-engine combination. Approval to conduct ETOP is made by the issuance of operations specifications containing appropriate limitations.

11. CONTINUING SURVEILLANCE. The fleet average IFSD rate for the specified airframe-engine combination will continue to be monitored in accordance with Appendices 1 and 4. As with all other operations, the certificate-holding district office should also monitor all aspects of the extended range operations it has authorized to ensure that the levels of reliability achieved in extended range operations remain at the necessary levels as provided in Appendix 1, and that the operation continues to be conducted safely. In the event that an acceptable level of reliability is not maintained, significant adverse trends exist, or if significant deficiencies are detected in the type design or the conduct of the ETOPS operation, the certificate-holding district office should initiate a special evaluation, impose operational restriction, if necessary, and stipulate corrective action for the

operator to adopt to resolve the problems in a timely manner. The certificate-holding district office should alert the Type Certification Office when a special evaluation is initiated and provide for their participation.

Anthony J. Broderick
Associate Administrator for
Regulation and Certification